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International Co-operation

Technical co-operation between British and Overseas foundries dates back to 1921 or even earlier. It was, however, not until 1926 that steps were taken to place matters on a properly organised basis. In the December of that year, Mr. P. Ropsy called the representatives of Great Britain, France, Belgium, and Germany to a meeting held in Brussels. Mr. T. Makemson, M.B.E., was elected honorary secretary—a position which he still holds. The Comité International des Associations Technique de Fonderie quickly expanded to embrace all other nations where it could be shown that a national foundry technical association was regularly functioning. Within a short time, America, Spain, Italy, Czechoslovakia, Poland, Holland and Hungary joined the Committee. International Congresses have been held in Paris (three times), Barcelona, London (twice), Liège, Milan, Prague, Philadelphia, Brussels, Düsseldorf, and Warsaw. In Paris in 1937, following a Report on Methods of Testing Cast Iron, a Committee was formed charged with the study of this subject. The honorary president is Professor Portevin and the active president, Dr. J. E. Hurst. We were present at its last meeting held last week in Liège, when it was decided to establish in tabular form the details of the test-pieces used and the minimum properties specified in the various countries. This report should be finalised for presentation at the first post-war congress to be held in Prague in September next year.

The invitation to participate in this function was accepted by the International Committee at a meeting which followed the one devoted to the testing of cast iron. Mr. J. Lobstein, who has been president of the Committee since 1940, is being succeeded by Mr. V. C. Faulkner—a founder member of the Committee; Belgium is to nominate a vice-president—probably Mr. Rene Deprez. He will preside over a meeting to be held in Holland in 1949. Owing to the reduction in the number of countries represented on the Committee it has not been found possible to establish a long-term series of conferences. Plans for the Prague Congress are already well forward. The first two days are to be devoted to technical sessions; then there is to be almost a week of works' visits with just a break at the week-end, to be spent in the Tatra mountains. Then the delegates return to Carlsbad for a closing banquet before returning home. The future prospects of technical collaboration of the world's foundry industry will depend upon the ability of the rising generation of the various countries to put as much into the work of the Committee as they expect to receive from it. There must be no one-way traffic in technology, and political and trade matters must be rigorously excluded.

The rules governing the work of the Committee are excellent and form a sound basis for proper international technical collaboration. Even the extraordinary difficulties of financing the work of the Committee can, and have been, overcome. There is need for much co-operation of this character in the future, and applications for membership will be sympathetically considered by the Committee from other nations providing a national foundry technical association already exists. The address of the secretariat is St. John's Street Chambers, Deansgate, Manchester, 3. Finally, on behalf of the various nations who were the guests of the Association Technique de Fonderie de Belgique, we most sincerely thank the members, president (Mr. Rene Deprez) and Council for the generous hospitality accorded.

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A Core Goes Awry

By W. G.

The moulder who made the casting shown in Fig. 1, got a surprise when he examined it the following morning. He discovered that the core had bulged in the centre approximately $\frac{3}{8}$ of an inch. The overall length of the core is 2 ft. 6 in. by $1\frac{1}{4}$ in. diameter, allowing 2 in. for top and bottom prints and is composed of oil substitute and sea-sand. The thickness of metal round the core is $1\frac{1}{4}$ in. The casting is bored, and machined on the outside and rings are then cut from it. Hence the reason for pouring the job on its end to ensure a dense and clean casting.

Produced on a core-extrusion machine it was not possible to reinforce the core with an iron rod and this safeguard was not considered necessary after testing the core for rigidity, as it broke when a slight effort was made to bend it.

The pattern was bedded in the floor and two joints, beside the one for parting the top box were made. The first joint was 4 in. from the bottom and it was at this parting that a number of spray-gates were cut round the mould in the belief that an equal volume of metal would encircle the core whilst the mould was filling, thereby preventing pressure at any side of the core and resulting in the core not being moved out of centre.

After a brief discussion, one is inclined to accept the theory that the core, absorbing moisture from the mould and losing a little of its resisting qualities, gave way to the downward thrust of the feeding-rod, the pressure from this forcing the core to one side.

Two methods were suggested to keep the core straight during pouring of the next two castings. One was to use a $1\frac{1}{4}$ in. strickle, making the core in halves and setting a $\frac{1}{4}$ in. rod in each half and scribing a vent in each of them when dry. The second method was to hold the core central by the use of three flat-head nails contacting the core and inserted at the middle joint, this latter method being adopted with success.

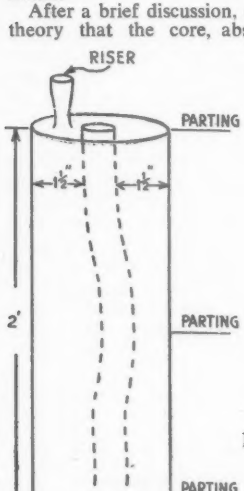


FIG. 1.—CASTING.

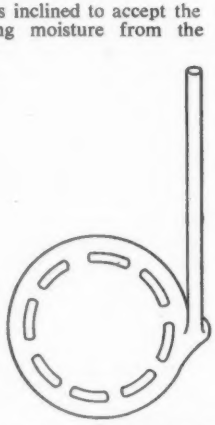


FIG. 2.—GATING ARRANGEMENT.

Institute of Metallurgists

During the first week-end in September the Institution of Metallurgists held their first Refresher Course for metallurgists in the L.M.S. School of Transport, Derby. Some 70 members lived and worked together over the week-end. The theme of the studies was "The Transformations in Solid Metals and Alloys," and seven lectures were given by eminent authorities on its various aspects.

Foundry Trades' Equipment and Supplies Association

The annual meeting was held on September 4, Mr. W. Rawlinson presiding. The accounts for the year ending December 31, 1946, having been adopted, the following were re-elected to the Council:—Mr. W. E. Aske, Mr. R. H. Brackenburg and Mr. V. C. Faulkner. The question of exhibitions of foundry supplies and equipment was discussed and all members are to be circularised for an expression of their views as to future policy.

At a Council meeting which followed, British Moulding Machine Company were elected members. Mr. W. H. Rawlinson was re-elected president and Mr. T. A. Hammersley vice-president. The question of shortage of foundry supplies and the meaning of "hard currency" were raised and suitable action taken.

Raising the Status of Employees

An interesting new scheme to encourage the entry of more recruits into the engineering industry has been adopted by the Bloomsgrove Works, Nottingham, of Manlove, Alliott & Company, Limited. Among other amenities is a special annexe in which dirty clothes can be changed and dirt washed off. It is hoped to have this in operation shortly, so that the foundry worker on his way to and from work will be indistinguishable from the clerical worker. Many other measures, including increased mechanisation and improved conditions, are either in operation or being planned. Mr. John Richards, a veteran employee with over 30 years' service, has been officially appointed "foster-father" to the firm's apprentices.

The Influence of Production Flow on Moulding Methods in Iron-Foundries*

By R. C. Shepherd

(*Continued from page* 33.)

Flask Moulding Repetition Work

A roller conveyor system is comparatively low in capital cost, but requires a high proportion of shunting labour, thus lowering production per total man-hour figures. Another drawback of these roller-conveyor systems is that tunnelling over the cooling section of the conveyor causes difficulty in hand pushing a long row of moulds through the tunnel. This can be largely overcome by using some form of live roller movement in suitable sections of the conveyor. Fig. 8 shows an example of live rollers used on a unit seen by the Author, operating in a German plant.

Fig. 9 illustrates the complete German roller-conveyor unit referred to above, which is similar to Fig. 5 in principle. In this case, however, it is interesting to note that the drag parts are blown in natural bonded sand instead of being made on moulding machines. Cope parts are made on the two moulding machines shown and closed direct on the drag parts, after these latter have been cored up on the gravity roller conveyor on which also the jobs are cast. After casting, the moulds are picked up by the live roller arrangement. The rollers revolve at 5 r.p.m.

Mould plates are, of course, required to support the moulds on rollers, involving an extra handling at the shake-out station. This factor, of course, applies to all roller conveyor systems. This unit was designed for one particular job, *viz.*, small diesel cylinder heads of a fairly complicated nature. Eight men in total were employed, including casting and shake-out, etc., and a figure of 6.25 moulds per total man hour was claimed.

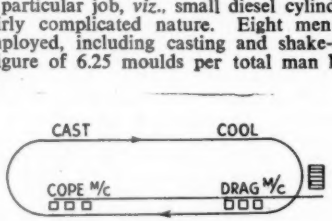


FIG. 6.—PALLET CONVEYOR UNIT.

Fig. 6 is the typical high speed continuous loop arrangement used in the U.S.A. and Britain. It is completely mechanised throughout. U.S.A. practice in particular separates the drag and cope machines. For special jobs this practice enables the exact number of drag and cope machines to be used. One U.S.A. plant, for example, utilised nve drag and only three cope machines to handle a sustained production of just over 200 moulds per hour. It was remarkable how the output from the three cope machines exactly matched the five drag machines output and showed the care that had been taken in the original time study.

Another U.S.A. plant seen by the Author operated seven drag and five cope machines. With the high total outputs involved in such units, the speed of movement is very high. Mould conveyor speeds of 25 ft. per min. are common, but the fastest mould conveyor seen by the Author was in a U.S.A. plant, running at 35 ft. per min. To cope with these speeds, casting is done on moving platform conveyors and elaborate mechanical equipment is used at the shake-out stations to deal with the enormous quantities of boxes, castings and sand involved.

Fig. 7 is identical in principle to Fig. 6, but utilises the German type over and under conveyor. Closing and casting are carried out on the top strand of the conveyor and cooling takes place on the bottom strand, which returns underground to the shake-out location where the conveyor plates automatically lift and deposit moulds on to the vibrating grid. Limitations to this type of conveyor are depth of boxes which can be handled and the mechanical efficiency of the conveyor. Fume extraction during cooling is facilitated by reason of carrying this out in an underground pit.

The above examples are typical of continuous foundry operation. In each of them provision is made for continuous uninterrupted *mould making* on appropriate machines. The type of machine varies with the job, *i.e.*, straight pattern draw, turnover, squeeze or jar-ram or both, and stripping plate. Further, cope and drag machines in the same unit can differ in type according to requirements. Details of handling and lifting boxes and half moulds depends on size and weight. Wherever necessary, mechanised handling devices should be considered if fatigue is likely to be encountered in a sustained period of working.

Rammed drag parts are put directly on to the casting conveyor and cores placed whilst in transit to the closing point, adjacent to the cope machines. Rammed copes are usually closed on the cored up drag parts directly from the cope machines. This necessitates perfect pattern stripping and runner formation. Box tackle and closing pins must be kept in first class condition and properly designed to enable fast and accurate

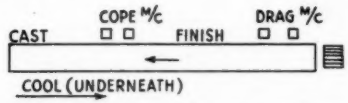


FIG. 7.—OVER- AND UNDER-CONVEYOR UNIT.

*Presented at the Nottingham Conference of the Institute of British Foundrymen. (Slightly Abridged)

Production Flow

locating as no time must be wasted in this operation if the machines are to be kept continuously operating. (Usually the cope machine operator does the actual closing). Casting, also, has to be made as foolproof as possible. It is common practice in the U.S.A. to fit filter cores on the joint of the drag part to ensure teeming on the move does not cause dirty castings. (See Fig. 10). Cooling time is controlled by the length of conveyor between the casting line and the shake out point. With very high outputs and/or heavy castings excessive conveyor lengths are necessary. Under these conditions, dividing the output between smaller units has to be considered. Provision should be made for fume extraction during the cooling period, either by hoods or tunnels. Shake-out equipment for all the work in this section should be mechanically operated and physical effort reduced to a minimum owing to heat, steam and fume conditions. The shake-out should be segregated from the production area and a great deal of attention must be paid to dust and fume extraction. If at all possible, arrangements should be made for hot castings and metal to be delivered directly into stillages, or on to conveyors, without manually lifting. Box return is an important item and should be planned in such a way as to limit manual effort to an absolute minimum. Wherever possible the use of bottom mould carrying boards or plates should be avoided

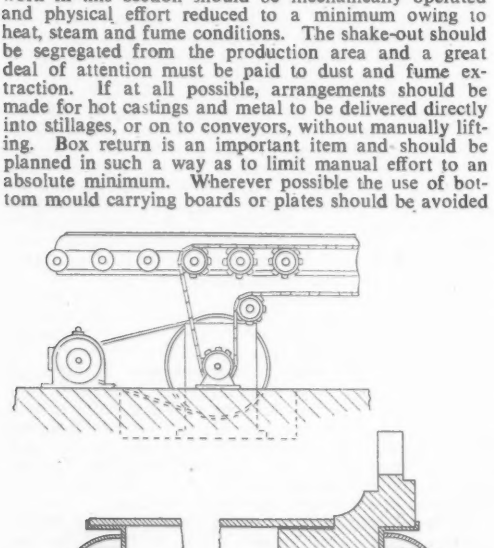


FIG. 8.—DETAILS OF LIVE PULLEY AND DRIVE.

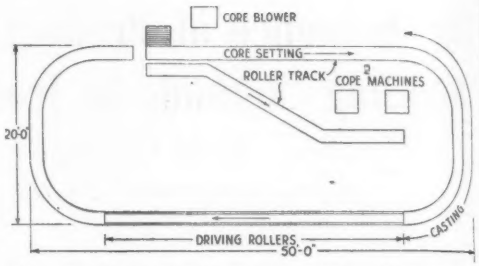


FIG. 9.—SMALL DIESEL CYLINDER HEAD CONTINUOUS UNIT.

as these entail extra handling at the shake-out and machine stations.

Snap and Flaskless Repetition Work

Many of the continuous units described in the last section can be adapted for this class of work with some little modification. This type of moulding lends itself to mechanised production as closing and shaking-out operations are comparatively simple. The absence of flasks at the shake-out is a good point as it saves an extra operation. There are, however, limitations in the range of work which can be produced in snap flasks. In view of this, the following description is given of a novel German application of the snap flask principle by means of which all the flexibility of flask moulding is obtained without the limitations usually encountered with snap flask working. It will be noted this method of procedure lends itself admirably to mechanised production.

Fig. 11 shows the arrangement for high speed production with this novel form of snap flask working. This method differs from ordinary snap work, as casting is carried out before the snap flasks are removed. The unit consists of a loop pendulum conveyor served by one drag and one cope machine. Rammed drag parts are put direct on the conveyor platform (no bottom boards are used) and any cores are set before reaching the cope machine, where copes are closed on the drags. The closed moulds, still in the aluminium snap flasks are then cast, after which they get a preliminary cooling period up to point (A). At this point, one operator removes cope and drag flasks (and returns them to respective machines *via* roller conveyor) leaving the rammed block of sand containing casting, runners, etc., to undergo a secondary cooling period whilst travelling to the shake-out, where the job is automatically tipped and shaken out.

Only 35 aluminium snap flasks are required to give a production of 100 moulds per hour, owing to the short period they remain on the conveyor. Six men only were required to obtain this output including all indirect labour. Mould sizes were 16 in. x 14 in. x 4½ in. x 4½ in. Castings weighed up to 45 lbs. each. This system and method has good possibilities for the right type of work.

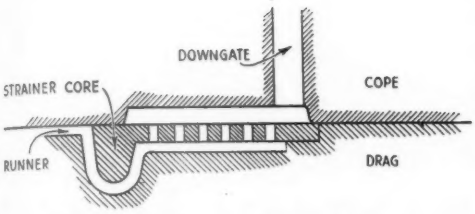


FIG. 10.—DETAIL OF STRAINER RUNNER.

(c) Built-up Core Moulds for Repetition Work

The practice of using cores to form the moulds (Chart I) for suitable repetition work is fairly common. The mechanised coremaking procedure involved is outside the scope of this Paper. The other operations are, principally, core assembly, casting and shake-out. The first two can be easily and satisfactorily performed on continuous mechanised systems, but the shake-out operation presents some difficulties, owing to the high dry strength of the sand. It is necessary to devise and instal special crushing equipment to deal with mixtures of hard sand lumps contaminated with pieces of metal. Careful job study is again necessary in order to synchronise the operational time cycles appertaining to any particular application.

(d) Precision Casting Process

This practice is coming into prominence largely for the production of castings in heat-resisting metals which are too hard to machine. It has therefore been found necessary to develop a process which will produce rough castings to very close dimensional tolerances. Chart I shows the operations involved are (1) production of a wax pattern from a master pattern, (2) investing wax pattern in a suitable refractory material, (3) drying investment and burning out the wax, (4) casting (usually in a fixture, by means of which pressure can be applied at the moment of filling the mould, and (5) stripping casting. All these operations are capable of being performed on a production flow basis, with similar units to those described in the previous section on flask moulding.

Small Work Batch Production Quantities

Chart II shows this class of work has been split into two main classifications: (1) flask moulding, and (2) snap moulding. Batch production, particularly of mixed work, presents difficulties when considering high speed mechanised production working, but by utilising the appropriate combination of bank or continuous operational working it is possible to apply production flow methods to a higher proportion of this class of work.

Frequent pattern changing is often considered to be a major snag preventing the adoption of high speed operation. This, however, can be overcome by providing spare machines in the system on which patterns are being changed whilst the others are working, thus giving continuous machine operation. This, of course, involves extra floor space and high capital expenditure. It is doubtful whether spare machines are really necessary except for exceptional circumstances. Moulding machines can be so rigged as to make pattern changing a matter of a minute or two only, and such short periods gives the operator a change of routine, which most of them take anyway at intervals during the working periods.

Another "snag" is the varying times encountered in closing and cooling. Where the mixture of work is such as to prevent anything like continuous working, banking can be resorted to for either or both operations and provision made for routing the work to and from the banked areas. Varying types of metal requirements may also prevent continuous casting, but again it is not difficult to arrange for this to be banked for batch pouring.

All these difficulties are very much aggravated where large operating units are concerned. Usually the bigger the unit the greater is the variation of work which has to be handled, so that smaller self-contained units are to be preferred in order to segregate as much as possible the various types of work. Taking an average output of, say, 40 to 60 complete moulds (according to size) per two machines per hour, this gives a complete unit having an output of, say, 300 to 450 moulds per eight-hour shift. In average batch operation this usually reduces the variation of product in each unit to within reasonable limits. Well organised units of this sort are capable of economically producing batches as small as twenty-four off any single pattern, provided it is mounted. Spares and service requirements from old mounted patterns often call for production of this sort.

Where pattern mounting is not justified loose split patterns can be used, providing the well known system of jigged dowels is used in conjunction with a jigged drilled fixture mounted on the moulding machine.

Flask Moulding Batch Production

Reference to Chart II shows that a variety of production flow systems are available to suit any reasonable range of batch production. These include complete continuous layouts (already described), complete bank and combination bank, and continuous production flow arrangements. These latter two are considered in this work group, and reference is also made to existing floor practice for the purpose of comparison. The table only shows combinations of three

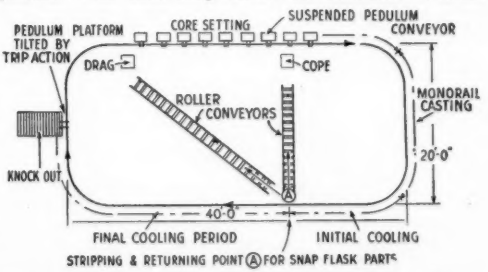


FIG. 11.—SNAP FLASK MECHANISED MOULDING UNIT.

D

Production Flow

basic operations, viz., closing, casting and cooling and shaking out. It should be understood these can be sub-divided at will if a particular job study indicates the need for special attention to be paid to some individual detail in procedure.

Bank Operation Floor Moulding is usually a combination of machine moulding with all subsequent operations performed on the floor. The main advantage of this procedure lies in its almost unlimited flexibility, as it is capable of handling an enormous variety of types, and can easily cope with small quantity production. Beyond this very little can be said in its favour. It has many drawbacks, principally:—

(1) low P.M.H. values; (2) large floor areas required for big outputs; (3) congestion on production floors; (4) excessive man-handling in such operations as moulding, cooling, casting, shake-out, box return and sand handling; (5) bad working conditions over large floor areas during casting and shake-out operations; and (6) poor co-ordination of effort between a group of workers, resulting in waiting time.

In British practice moulds are usually closed singly on the floor, whereas continental practice favours stacking moulds wherever possible, in order to conserve

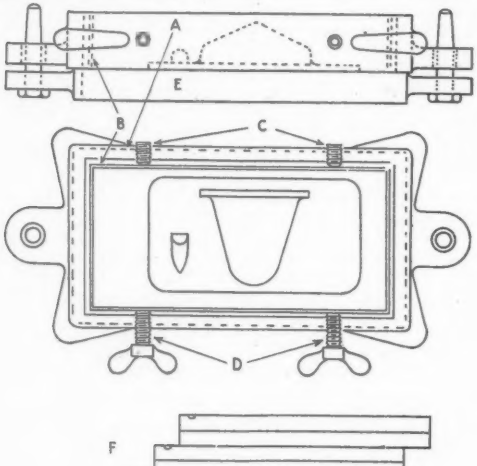


FIG. 12.—STACK MOULDING SYSTEM,
A is the aluminium master moulding box; B, sheet steel or light C.I. inner casing; C, fixed set screws; D. adjustable fixing set screws; E, pattern plate or plaster pattern; and F, stacked moulds.

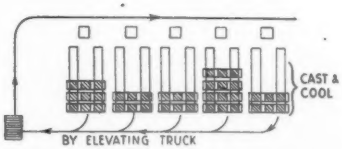


FIG. 13.—SNAP FLASK LAYOUT.

floor space. Stacks up to six high are handled satisfactorily in this way.

The same procedure applies to both flask and snap flask moulding, but it is of interest here to note that German floor snap moulding differs from British practice. With the German practice quite large outputs are obtained and conservation of floor area is obtained by stacking the moulds. Separate machines, each equipped with separate aluminium master "form" boxes (Fig. 12), make copes and drags. The "form" box has two fixed locating points and two adjustable locating points for locating a thin sheet steel or cast iron inner casing. The procedure is to locate the "form" box on the pattern plate mounted on the machine. Next, the inner casing is fixed inside the "form" box by means of the adjusting screws. The mould is rammed in the usual way. The drag part (in the "form" box) is placed on the floor and the corresponding cope part closed on to it with loose pins. The adjusting screws are then loosened on the cope part and the cope form box withdrawn by hand. This procedure is repeated with the drag part, leaving the two half moulds each inside its own casing accurately located. The advantage of this method is that it allows separate operators to make copes and drags, thus speeding up production and, secondly, the sand mould is protected its full depth by the inner casings and not just along the joint as in ordinary snap flask work. It also obviates the need for large stocks of expensive moulding boxes.

Bank Conveyorised Systems

The usual British practice is to utilise roller conveyor throughout for mould conveyance from operation to operation which involves rather high shunting labour, thus lowering the total P.M.H. values, despite the fact that the production per direct man hour may be quite reasonable. Another drawback is that casting over a wide area does not lend itself to easy local fume extraction, so that general shop ventilation is about the only method that can be applied.

Production units of this type are usually considered in connection with green sand work, but dry sand moulding can also be handled on a production flow principle. Typical American practice is to skin-dry wherever possible, either by flame torch (natural gas) or by spraying with mixtures of wood alcohol and blacking and igniting while on the production line prior to core setting and closing. British skin-drying practice is usually done by gas or oil torch, or by an overhead heated air unit under which the half-moulds are intermittently fed. Any of these practices can be applied to an appropriate production flow system. In excep-

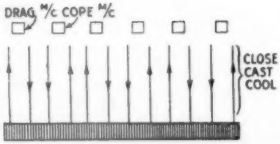


FIG. 14.—LAYOUT WITH SHAKE-OUT GRID.

tional cases, or where large outputs are required, continuous drying stoves are used. Alternatively, provision can be made to side-track half-moulds to batch drying ovens and after drying feed back continuously into the system for all subsequent operations.

Fig. 13 illustrates a well-known layout* commonly used in the U.S.A. for snap flask work. A single row of machines served by overhead sand supply are used for continuous moulding. Lengths of roller conveyor for the machines are spaced so as to take a tray capable of holding three moulds. The length of each pair of roller conveyors controls the storage capacity of the system. Casting (and/or closing) of moulds is performed whilst on the roller conveyor bank. As the moulds are hand pushed away from the machines they move towards the end of each length of roller, where after casting and cooling they are picked up by elevator truck and taken to a mechanical shake-out. This can be conveniently situated for easy box return (by roller conveyor) and for sand transport by means of belt conveyor, to the sand treatment plant and ultimately back to hoppers over the machines. This is a very good system as the mould shunting effort is restricted to straight lengths of roller and all other movement to the shake-out is done mechanically and very simply by means of elevator truck. The main drawback is the need for casting over a wide area, thus complicating fume extraction.

Fig. 14 shows a similar system to (*a*) except that the shake-out operation is performed at the end of each length of roller conveyor on a shake-out grid running the whole length of the ends of the conveyors. This layout is usually employed for flask moulding. More manual effort is required in shaking out, as a length of grid is used instead of a single mechanical shake-out. Further, box return rollers take up valuable space which would otherwise be used for mould storage. This form of shake-out also leads to bad fume and dust conditions, owing to the difficulty of extracting over the whole of a large grid area.

Fig. 15 is another variation in which the moulds change direction from the ends of the closing and casting rollers and are transferred to the banked shake-out rollers either by means of a traverser or another length of roller. This system has the advantage of being capable of being fitted with a mechanical shake-out, but with an all roller system needs a large labour shunting and mould transfer force. This can be reduced somewhat by incorporating a mechanical conveyor of the slat type, in place of the roller, for transferring moulds from the casting conveyors to the shake-out.

Fig. 16 is a layout suited for small units dealing with work which requires only short closing times, but which does require a more lengthy cooling period. It is not suited for units having more than four machines, as the layout then tends to become cumbersome. This unit can be very well operated with two machines working and the other two having patterns changed. It has the usual drawbacks of requiring shunting labour, grid shake-out and difficult dust and fume extraction.

Fig. 17 is a layout using a moving bank conveyor for casting and cooling. Moulds are made on a line of machines and closed on straight lengths of rollers, from where they are transferred to a large capacity intermittent winch operated conveyor, made up of a series of long narrow bogies linked together, which has a large casting and cooling capacity. This system obviates the need for a large shunting labour force. It is very flexible and offers possibilities of serving a multiple number of miscellaneous ramming and closing stations and is particularly applicable for medium and large size green sand work.

The main disadvantage is that the empty bogie return from the shake-out end is not automatic and has to be done by means of an overhead crane. The spaces between each bogie give good accessibility for casting (which is done by means of an overhead crane), thus facilitating batch casting of various metals. This unit layout enables the bogie conveyor to be segregated from the moulding and closing area, thus facilitating casting fume extraction. It is particularly applicable to the larger jobs in this work group.

Combined Bank and Continuous Production Flow Systems

Banking can be resorted to at will for any of a series of operations calling for special treatment. For example, if the three main operations (1) closing (2) casting, and (3) cooling and shake-out are taken, the following six combinations, or basic systems, are obtained:—

Operation.	System Combination.					
	1.	2.	3.	4.	5.	6.
Closing ..	Bank	Bank	Bank	Continuous	Continuous	Continuous
Casting ..	Bank	Continuous	Continuous	Bank	Bank	Continuous
Cooling and shake-out	Continuous	Continuous	Bank	Bank	Continuous	Bank

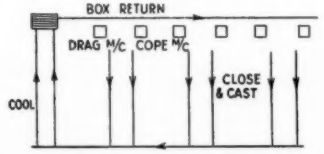


FIG. 15.—LAYOUT WITH MECHANICAL SHAKE-OUT.

* Transactions of A.S.M.E., May, 1944. Volume 66. No. 4. "Design Features of Conveying Equipment for the Foundry Industry" by F. B. Henry and G. N. Wileman.

Production Flow

Closing Bank; Casting Bank; Cooling and Shake-out—Continuous

The above combination of operational working is suitable for work requiring some latitude in closing and casting, but where uniform sections allow a constant cooling time. This permits a mixture of work having varying closing times and calling for different types of metal, *i.e.*, alloy additions, or where batch melting is the practice and a complete melt of metal has to be disposed of quickly. The amount of storage space allowed controls the operating time cycle periods, or, in other words, the amount of flexibility.

Fig. 18 shows a typical roller conveyor layout where rammed parts are uninterruptedly made on a battery of machines and placed on lengths of roller conveyor for banked closing and casting. Where maximum flexibility is needed for these two operations the procedure of using alternate machines can be adopted. Immediately after casting, moulds are quickly transferred to a mechanical or roller conveyor continuously feeding the shake-out. Fig. 19 shows this combination of operational working applied to the linked bogie conveyor unit arrangement.

Closing Bank; Casting—Continuous; Cooling and Shake-out—Continuous

This combination is suitable for work requiring latitude in closing, but which can be continuously cast with one class of metal, and can be given a uniform cooling period because the work is of a uniform section.

Fig. 20 is again the typical roller conveyor layout, but in this case the moulding-machine rollers are confined to the closing operation. Again the degree of flexibility in closing may be altered by varying the lengths of the closing rollers, or by alternate moulding machine operation. Closed moulds are transferred after closing to a straight roller or mechanical conveyor line for continuous casting from an overhead mono-rail. After casting, moulds are continuously and regularly conveyed to a mechanical shake-out.

Fig. 21 employs the same principle on a loop-type all-roller layout. In this case, however, the closing operation is not quite so flexible as only one length of roller is used for dealing with the rammed parts from the cope machines, but a fair degree of selective closing treatment is possible. As before, casting, cooling and shake-out operations are continuously performed.

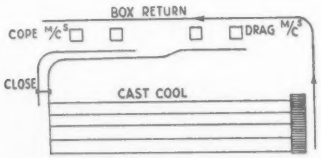


FIG. 16.—SMALL UNIT LAYOUT.

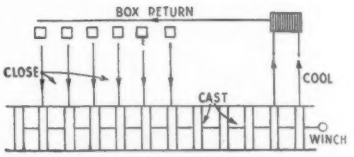


FIG. 17.—LAYOUT WITH BOGIE CONVEYOR.

Fig. 22 is the same arrangement as Fig. 19 above, but employs a mechanical loop pallet conveyor for continuous casting and transportation to the shake-out station. This layout allows maximum flexibility in closing, combined with mechanical mould handling for all subsequent operations. Fig. 23 again employs the pallet loop conveyor, but in this case a single-line roller conveyor is used from each cope machine for the closing operation.

Closing—Bank; Casting—Continuous; Cooling and Shake-out—Bank

In this combination only casting is performed continuously, all others being banked. This is suitable for work requiring extended or varying closing times, by reason of varying degrees of coring and which also differs in section thicknesses. Fig. 24 is the typical roller unit arranged with bank rollers for closing, a single-line mechanical or roller conveyor for continuous casting and banked rollers to the shake-out which enables heavy jobs to be segregated from the light ones after casting.

Fig. 25 employs the same principle with a loop roller unit, having the single-line bank closing conveyor arrangement. Fig. 26 employs the mechanical over and under type conveyor, together with a single-line roller for selective closing.

Closing—Continuous; Casting—Bank; Cooling and Shake-out—Bank

This combination is suitable for simple or non-cored work, but which differs considerably in section sizes and metal composition requirements. Fig. 27 is an all-roller conveyor arrangement where copes are continuously closed at Point "A," after which moulds are transferred to banked rollers for casting and cooling. Moulds are shaken out at the end of each roller on to a long floor grid. Fig. 28 employs the linked bogie conveyor for bank casting and cooling on which the cast moulds are mechanically transported to bank rollers for further cooling selectivity before reaching the shake-out.

Closing—Continuous; Casting—Bank; Cooling and Shake-out—Continuous

Work suitable for this combination is simple in coring and of uniform section, but which calls for varying metal requirements. Fig. 29 is an all-roller arrangement on which continuously closed moulds are transferred to bank rollers for casting, after which they are continuously fed to the shake-out station.

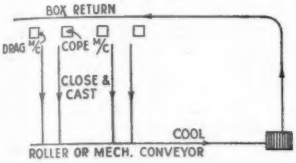


FIG. 18.

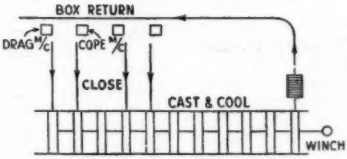


FIG. 19.

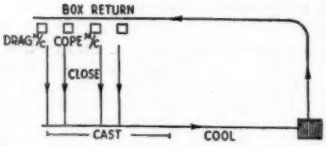


FIG. 20.

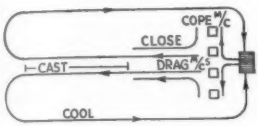


FIG. 21.

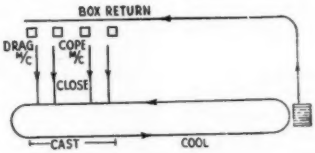


FIG. 22.

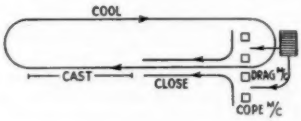


FIG. 23.

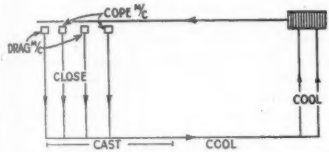


FIG. 24.

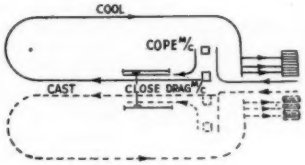


FIG. 25.

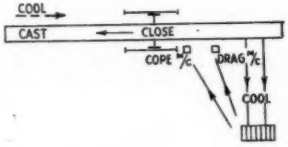


FIG. 26.

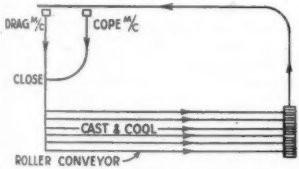


FIG. 27.

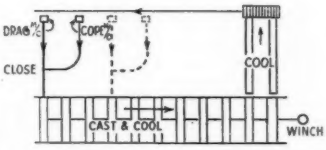


FIG. 28.

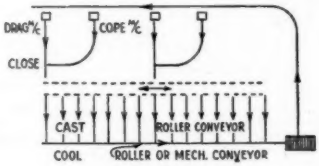


FIG. 29.

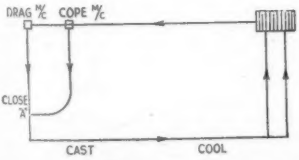


FIG. 30.

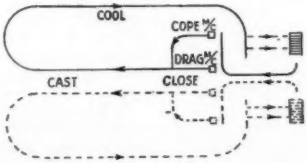


FIG. 31.

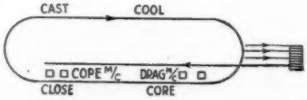


FIG. 32.

FIGS. 18-32.—COMBINED BANK AND CONTINUOUS SYSTEMS.

E

Production Flow

Closing—Continuous; Casting—Continuous; Cooling and Shake-out, Bank

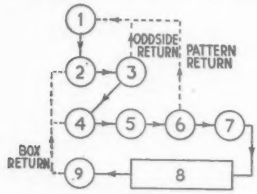
This combination suits work of a simple or non-cored variety which can be cast with one metal, but which varies considerably in section sizes. Fig. 30 is the typical roller unit on which closing is continuously performed at point " A," after which the closed moulds are continuously cast on a single line roller or mechanical conveyor, from where they are mechanically pushed to bank rollers for selective cooling and shaking out. Fig. 31 utilises the loop type roller unit; Fig. 32 is the same in principle, but utilises the pallet type conveyor.

Snap Flask Moulding Batch Production

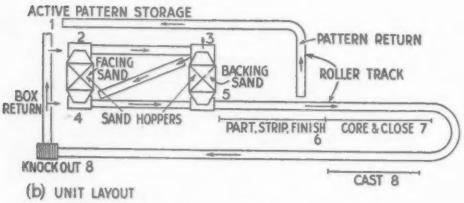
Here again appropriate bank and combined bank and continuous layouts can be adapted for batch production. Variations likely to arise in this class of work are mainly different metal requirements and varying cooling times, and both of these variables can be catered for by providing the right combination of bank/and/or continuous operational working.

Small Work Oddments Production

It is, of course, common practice for skilled floor moulders to make this class of work. In doing this they are called upon to perform many operations that can be done by less skilled labour. Chart III shows typical sorts of varying pattern equipment handled in this work group. Some foundries may have to deal with only one or two pattern types, others may have to cater for some considerable mixture of pattern equipment. This difficulty, no doubt, explains the reason for the practice of individual floor moulding persisting for so long. This type of work constitutes a fair proportion of the industry's jobbing output, and the oddments so produced are, without doubt, of vital importance to industry in general. The products of such jobbing foundries cover a multitude of applications, such as spares and repairs from old patterns, installation details and jigs from new cheaply made patterns and the many one-off jobs for special engineering work.



(a) FLOW DIAGRAM



(b) UNIT LAYOUT

FIG. 33.—SMALL WORK ODDMENTS PRODUCTION (USING FACING SAND), SHOWING:—
1, Pattern delivery and fix pattern; 2, Box on, add facing sand and pack; 3, Add backing sand, ram and turn over; 4, Bottom box on, add facing sand and pack; 5, Add backing sand and ram; 6, Part, strip pattern and finish mould; 7, Set cores and close; 8, Cast; 9, Knock out.

Obviously, in looking for a production flow system to apply it is necessary to find an arrangement which is flexible enough to digest as many as possible types of pattern equipment and as wide a range of moulding flask sizes as is practicable.

In carrying out this type of work a number of basic operations (common to any type of small moulding work) are performed. The main difference in operation lies in the mould making practice. Due to the nature of the patterns more operations are often involved in the actual making of the mould than is the case with repetition and batch work. If it is possible to break down the job of mould making into constituent operations then a production flow scheme becomes possible. Such a procedure would result in all work being kept off the floor, with improved working conditions, and it becomes possible then to select the right type of labour for each operation and so increase the skilled labour capacity in this section of the industry and quite possibly the P.M.H.

In effect, production flow operation involves the ganging up of operators for simultaneous operational working in contrast to a number of men working independently. To warrant such ganging up, the main factor is the ultimate increase in the P.M.H. and increased total outputs which, experience indicates, should follow from the adoption of planned production methods.

In making a decision, the first approach must be to ascertain the P.M.H. of the existing output and then to compare this with the expected P.M.H. on the output planned for a production flow unit. The essential factor is a sufficient overall output which, when broken down into constitutent operations, provides sufficient work at each stage to keep at least one operator fully employed. The minimum unit size which can be successfully operated must depend upon individual conditions, but, broadly, it may be taken where six or more mould making operators can be fully occupied. then an investigation of the case for production flow operational working is warranted.

It is obviously impossible to detail here all the operational studies involved in handling every type of different pattern equipment, but it is hoped the typical examples given will show how production flow operations can be applied. Fig. 33(*a*) shows a production flow diagram of operations involved in making castings from either loose solid patterns (with either sand or plaster oddsides) and double-sided pattern plates or boards.

Fig. 33(*b*) shows a conveyor production unit planned from it. The routing of operations is so arranged as to bring the two facing sand operations, Nos. 2 and 4, to one point, which is served by a trouser-leg overhead hopper. The backing sand operations, Nos. 3 and 5, are similarly arranged with a single point overhead sand supply.

If, however, sand practice and equipment suitable for using a single purpose sand can be adopted, then some simplification of layout can be obtained. Fig. 34(*a*) shows a production flow diagram of operations for both solid patterns (with oddsides) and double-sided pattern plates, or boards, when using a single purpose sand. Fig. 34(*b*) shows the layout evolved from it.

One of the main advantages to be derived from such a layout is the flexibility obtained in regard to box sizes (usually one of the biggest variables in this class of work) as ramming is either done by hand, hand squeeze, or by sand-slinger. Even with hand-ramming, considerable saving in the total job time can be expected as the operators are not hindered by such extraneous work as pattern and box searching and preparation, sand handling, shaking out, and are therefore able to perform their respective and appointed operations uninterruptedly, with an absence of hidden waiting time. Again, such arrangements only involve simple prepared sand delivery to a single point, instead of to a multiple number of ramming stations or floors. This applies more or less to all other unit equipment, so saving multiplication of equipment which would otherwise be necessary to service a number of operators spread over a large area.

The extent to which mechanical lifting and turnover facilities are provided depends largely on the maximum size of job, but as all these operations can be confined to a definite point, then installation becomes a comparatively simple and cheap matter. Again, by synchronising each operation, each piece of equipment is available the moment it is required, thus avoiding the many vexatious waits which usually occur when equipment has to be shared by a number of operators.

To ensure smooth working and maximum flexibility it is necessary to provide sufficient banking capacity between each operating station, so that varying operating times can be averaged out. One of the advantages of this system of working is the relief afforded to operators in fatigue and discomfort caused by constant stooping and kneeling on floors, which are invariably dirty and damp. All manual effort can be arranged to be performed at a reasonable working height on some form of conveyor, thus bringing the job into line with other sections of the engineering industry.

It is possible such procedure as has been outlined is likely to cut across many established practices and it is likely to meet opposition, even from some operators. Tradition dies hard, but it is difficult to conceive that skill, as it is often now defined, should involve such effort as shovelling, lifting, riddling, fetching and carrying, stooping and kneeling, even in the production of oddments.

(To be concluded.)

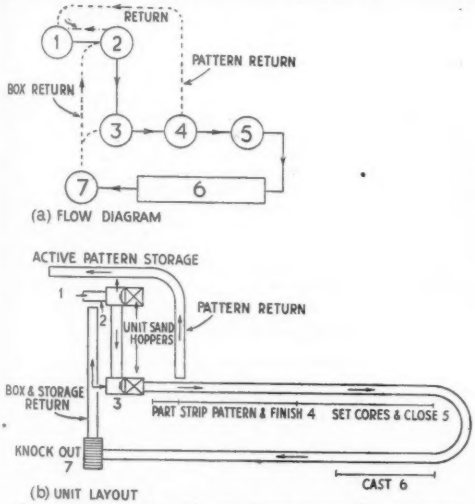


FIG. 34.—SMALL WORK ODDMENTS PRODUCTION (USING UNIT SAND), SHOWING:—
1, Pattern delivery and fix pattern; 2, Box on, add sand, ram top, part, turn over and remove odd side; 3, Bottom box on, add sand and ram; 4, Part, strip pattern and finish mould; 5, Set cores and close; 6. Cast; 7, Knock out.

Technical Photography

There are being held in London in September two exhibitions. The Institute of British Photographers opened their exhibition at the Alpine Gallery, 74, South Audley Street, London, W.1, on September 5. It remains open until September 30, and is designed to show how photography can help exports. The second is organised by the Royal Photographic Society of Great Britain. Part I, opened at 16, Princes' Gate, S.W.7, covering "Pictorial" and "Colour," closes on October 5. Then on October 11, Part II opens with "Scientific," "Nature," "Record" and "Technical." This will continue until November 1.

Vauxhall Motors

Early in September the Vauxhall Motors, Limited, brought their heads of departments to town to meet the Editors of the technical Press at a luncheon held at the Hungarian Restaurant, Haymarket. Our representative had quite a lecture on the unreliability of castings, their lack of machinability and tardiness in their delivery, but there was an appreciation of the difficulties of the moment and, generally speaking, their engineering staff were satisfied with the service they were obtaining. The Vauxhall Company are interesting themselves in the production of Kirksite castings, and the making of precision components by the lost-wax process.

A New Moisture Tester

A fast and accurate portable electric moisture tester to be known as the Moistmeter is now perfected and marketed by the Harry W. Dietert Company of Detroit. The sand sample under test is held within a curved sampling plate, similar to the cup formed by one's hand, and compressed to a definite degree by means of a spring-loaded arm. The sand slides through the sample cup and wipes electrodes as the Moistmeter is pushed into the sand pile. Thus a moisture test may be made at any depth up to 30 ins. from the surface of the sand.

The equipment has a dial thermometer incorporated to measure the temperature of the sand being tested: in this manner, correct adjustment is made to compensate for sand temperature. The percentage moisture may be read immediately from the upper dial as soon as the operator inserts the Moistmeter into the sand and releases his grip from the lower lever.

Since the electrical characteristics vary for each type of sand, it is necessary, when exact moisture percentage readings are desired, to calibrate the Moistmeter. This is accomplished by turning the right hand "sand factor" dial pointer to a predetermined number according to the type of sand being tested. Then adjust the temperature factor dial pointer to agree with the dial thermometer reading and the Moistmeter is ready to make accurate moisture readings as fast as the operator can record them.

FIG. 1.—THE MOISTMETER IN USE.

Protection of Iron Castings Against Corrosion

One of the main essentials in combating rust is the ensurance of an absolutely clean surface before protective coatings are applied. With this end in view The General Electric Company, Limited, has recently installed in its Witton Engineering Works a new pickling and priming shop for the treatment of cast and fabricated ferrous components for the extensive range of electrical products which they make. Such components are subjected to this treatment as standard practice immediately they leave the foundry or welding departments, and are thereby rendered rust proof so that, if necessary, they can be stored in the open without fear of deterioration. Furthermore the treatment provides a protective coating which serves as an ideal base for the reception of the finishing processes subsequently employed.

After treatment in an aqueous degreasing solution, the components are pickled in a hot acid solution, which contains an inhibiter in order to prevent the acid seriously attacking the metal itself, and a foaming agent which traps the acid vapours. All trace of acid is removed by washing first in cold and then in hot water, which latter serves also to pre-heat the components before they pass into the next tank, where they receive a protective phosphate film. A subsequent swilling in hot water followed by immersion in very dilute chromic acid serves to seal the phosphate film. The chromic acid is maintained at a temperature approaching that of boiling water, so that the components are hot when transferred to the draining table. Drying of the solution is thus very rapid, while if necessary it may be hastened by means of a high pressure blow gun. While still hot, the components pass into the spraying booth, where they are given a light coating of primer paint, which is applied by means of a spraying apparatus and dries almost immediately on the hot metal. The paint is thoroughly mixed in an electrically-driven mixing machine before entering the pressure vessel of the spraying apparatus, where it is kept continuously mixed. A powerful exhaust fan serves to remove all fumes from the spraying booth.

Forthcoming Events

Institute of British Foundrymen.

SEPTEMBER 24.

London Branch:—Presidential Address by E. M. Currie. Followed Mr. J. B. Blakeborough's film "Sandstorm Secrets." At the Waldorf Hotel, Aldwych, London, W.C.2., at 7.30 p.m.

Birmingham Branch:—Presidential Address by A. G. Harrison. Discussion on J. Hird's "F. J. Cook Award" Paper. At the James Watt Institute, Great Charles Street, Birmingham, at 7.15 p.m.

SEPTEMBER 26.

Falkirk Section:—"Some Personal Impressions of American Foundry Practice" by T. Makemson, M.B.E., at Temperance Café, Lint Riggs, Falkirk, at 7.0 p.m.

SEPTEMBER 27.

West Riding of Yorks Branch:—Visit to Crofts (Engineers), Limited, Thornbury, Bradford, at 2.30 p.m.

Book Reviews

The C.F.A. Bulletin. The latest to be issued—General Bulletin No. 21—not merely maintains the level of interest shown by earlier ones, but enhances it. The inter-dependence of ironfounding and pig-iron manufacture is clearly demonstrated by the impacts likely to occur during the winter. The value of statistics increases with their regular publication and the 43 divisions are adequate to allow most firms to see whether they are in line with general trends.

The Standard Conditions of Sale have now been in existence long enough to evaluate public reaction. This in general is most favourable. A case is cited of a "try-on" by a customer threatening to take action at law to recover "consequential" damages incurred by lateness in delivery. This case is well covered under "Conditions of Sale," apart from the fact that consequential damages are not, generally speaking, recoverable. The C.F.A. has contributed a number of interesting exhibits to the centenary exhibition organised by the old students of the Liége University. Two interesting law cases are quoted, the second, dealing with guards on circular saws, being of special interest.

Grundlagen der Eisengewinnung, by Dr.-Ing. R. Durrer. Published by Verlag Francke A.-G., Berne, Switzerland.

The title of this book could be translated as Fundamental Principles of Iron and Steel Manufacture. Very methodically and in great detail, the author deals first with the reactions which take place in the blast furnaces. Later some space is given to the electric system of smelting iron ores, together with a short description of the Krupp low-temperature reduction process. Then follows a consideration of liquid metal, when a return is made to the solid fuel and electrically-operated blast furnaces. Some of the sketches refer to patented notions rather than established systems. This seems to be characteristic of Continental text books and has much to commend it providing the student is informed of true position. For instance, on page 194, there is a diagram of the Kjellin furnace, but no information is given either of the name of the inventor or of the reason for its failure, or the rise and fall of its successor the figure 8 variety. As a text book, the reviewer finds it rather too logical and insufficiently descriptive to maintain the interest of the student. The book is written in German throughout.

V. C. F.

New Catalogue

Motor Control Gears.—Brookhurst Switchgear, Limited, Chester, have sent us a copy of the brochure "Short Delivery Standards." In 36 well illustrated pages it deals with a dozen main types of equipment, divided into hundreds of sizes, which are reasonably easily available. The worst is four months' delay, whilst much is available from stock. Much useful commercial data have been included and excellent use has been made of the space available.

Notes from the Branches

Cape Town

In a Paper to the Cape Town Section of the Institute of British Foundrymen, entitled "Nickel Bronze Alloys," MR. F. G. FORD included some practical information as to the method of melting 100 lb. of high nickel content alloy using an oil-fired crucible furnace. He stated that the normal time for melting should be 1½ to 2 hrs., the alloy being 40 per cent. nickel, 5 per cent. tin., 1 per cent. zinc and the balance copper. (1) The first operation is to preheat the crucible to blood red, before any charging is attempted. (2) Place 2 lb. of dry manganese ore, of black copper oxide, in the bottom of the crucible, followed by 40 lb. of pure nickel pellets and 54 lb. of copper. This must be superheated to 1,450 deg. C., at which point positive oxidising takes place. This process means that the oxidiser (dry manganese ore or black copper oxide) combines with copper and nickel, producing an oxide. (3) Add 12 ozs. to the pound of metallic manganese, 2½ to 3 ozs. of metallic silicon (an alternative is ferro-silicon to the amount of 5 to 7 ozs. of 50 per cent. ferro-silicon). These additions are purely as deoxidisers for, as can be seen, after the oxidising procedure, then de-oxidising must take place to bring about the removal of carbon monoxide and sulphur. The deoxidisers should only be added about 7 min. before the alloy is ready to be tapped from the furnace. (4) Add 1 lb. of black zinc by plunging it under the surface, preferably with a ball strainer, or metal plunger rod, and then add 5 lb. of black tin. The nickel bronze alloy is then brought to the maximum temperature of 1,450 deg. C., after which the air blast and fuel can be shut off. The metal can now be exposed on its surface and 1 oz. of metallic magnesium is added as a further deoxidant. (5) The last operation is to dust the surface of the metal thickly with powdered lime, which is then skimmed-off clean. The alloy is now ready for pouring into the mould.

It should be noted that the use of metallic manganese is preferred not only as a deoxidiser, but also because of its preferential combining power with sulphur, which will lower the sulphur content in the alloy, sulphur being deleterious. The actual action of metallic magnesium is to change sulphur to magnesium sulphate at the amount of about 0.08 per cent. The magnesium sulphide is then evenly distributed right throughout the metal in very small granules, which are not harmful in weakening the structure. With increasing amount of nickel in the alloys, the pouring temperature correspondingly rises from 1,200 deg. C. at 5 per cent. nickel to 1,450 deg. C. at 40 per cent. nickel.

LANSING BAGNALL, LIMITED, of Worton Road, Isleworth, Middlesex, have recently placed on the market a new design of 10 to 12 cwt. platform truck which is powered by either a petrol engine or an electric motor, the two types of power unit being readily interchangeable. When used as a tractor the truck can pull a load of 3 tons.

Hampton Court Clock

Restoration Work discloses interesting facts about early Bell-Founding

FIG. 1.

Recently *The Times* disclosed that in connection with the restoration of the Hampton Court clock, it was discovered that the two quarter bells were made by William Culverden. The cleaning was undertaken by Mears and Stainbank, who found the mark illustrated in Fig. 1, which has been identified by Mr. A. D. Tyssen. The centre of the shield is occupied by a large bell, on which the letters FOWN of the word founder are visible: below are a W and a figure of a bird. On either side are inscribed the words FN DNO COFIDO with a trefoil and DE below: and in the base is a mark like two P's conjoined, one being reversed.

The name of Culverden being known as that of a founder from records of the period, is was ingeniously pointed out that culver is an old English word for 'pigeon,' the kind of bird evidently here represented. Combined with the W and DE we thus get 'W. Culverden.' Now the significance of the text is apparent, for the Vulgate of Ps. x (xi), i, runs: *In Domino confido; quomodo dicite animae meae, transmigra in montem sicut passer.* The other two marks are still unexplained, but the trefoil may indicate a reference to the Holy Trinity, Culverden having had some relations with the Priory of that name in Aldgate."

The hour bell was cast by Thomas Harrys, a London founder, between 1478 and 1480. Our correspondent, Mrs. Ray Hughes, M.A., has supplied the following notes on Culverden and Harrys.

William Culverden, "citizen and brasier of London, and Parishioner of Sanct Botulph without Aldgate of London,[1] seems to have had an extensive business as bellfounder, though comparatively few of his bells remain, and those chiefly in Kent, Middlesex, Essex, Hertfordshire, Dorset and Cambridgeshire. As far as can be ascertained, Culverden's school life ranged from 1490 to 1500 or thereabouts. Evidently he was carrying on his business as founder in 1510, for in that year his name occurs in the parish accounts of St. Mary-at-Hill, London, the "great bell" of which church was re-cast by him. His foundry shield bore the device of a large bell surmounted by a cross, with the words "In d'no co'fido" on either side, underneath being a trefoil and the letter W and the figure of a bird, which, together with the P below the tongue of the bell, at one time caused certain theorists to surmise that the founder's name was William Pecocke. Later, however, it was satisfactorily proved that the shield must be that of William Culverden, "culver"[2] being the old word for wood-pigeon, probably a corruption of the Latin "columba," a dove. Apparently a bell still remaining in 1882 at Takely in Essex was his first effort at bell-casting. This bore his remarkable rebus, together with his own inscription,

"+Assit Principio Sancta Maria Meo,"

his superior schooling having enabled him to write a good pentameter.

His will, made on September 29, 1522, "in the xiiijth. yere of the reigne of king Henry the viijth," shows the steadfastness of his character and his gratitude to his teachers and his gilds. From it one learns that he was educated in the Abbey at Westminster. That he appreciated his time there is proved by his leaving "xxxiijs. viijd. for the welth of my soule yf it may be borne of my goodes after my detts be fully paide or ells not." The Houndsditch house where he lived in 1522 he bequeathed with its contents on payment of a yearly rent to another bell-maker—Thomas Lawrence of London. To him also he left his bell-moulds and all implements and material belonging to his craft on condition that £120 should be paid to him or his executors. It is probable that this Thomas Lawrence is the founder to whom is attributed the tenor bell at Kingston which bears the device of a gridiron, the symbol of his namesake Saint Lawrence. After providing for the payment of his yearly subscriptions to his guilds, he bequeathed the residue of his "goodes, catalls and detts—detts paid, funeral costs doon and bequests fulfilled"—to his four friends, Sir Roger Preston clerk, Sir John Osborne clerk, William Gurrowe "talughchaundeler" and John Ryon "fruterer," citizens of London. Alas for all William Culverden's good intentions, he did not leave enough for his executors to carry out all his instructions. He died in 1523, a typical honest Tudor craftsman—one of the more enlightened founders of the London group.

Thomas Harrys

[It is interesting, by the way, to note that the Thomas Harrys, London founder, who cast the hour bell at Hampton Court Palace, was responsible for the first recasting of the second of the five bells which formerly hung in the clochard of King's College, Cambridge, in the original structure of 1466. The large sum (for those days) of £10 9s. 8d. which was given him "pro mutacione secunde Campane" hardly seems warranted when one finds that the bell lasted only twenty-two years. When the bell was brought home Mr. Harrys was reputed to have drunk five pennyworth of wine in honour of the occasion, while the very moderate sum of three pence was spent on beer at the casting.]

[1] The designation he gives himself in his will of 1522.

[2] This word is included in the Dictionarium Resticum 1681 by John Worlinge of Petersfield "——a pigeon or dove; thence 'culverhouse.'"

Hand - to - Mouth

By "Onlooker"

One hears a good deal nowadays about the need for incentives in order to ensure the utmost endeavours of operatives to the betterment of production, and it may be accepted as axiomatic that humanity for the most part requires its rewards in tangible form and within a reasonable time after the exertions which have earned them. But it is not only in the realms of production that the prospect of a prize acts as a spur to effort, for on the commercial side of industry there is a constant striving after the best. While the salesman seeks to secure the best possible price for his goods, and to this end keeps a sharp eye on their quality, the buyer wants to make his purchases in the lowest market so long as he can make sure of continuity of supply. In the realm of non-ferrous metals the buyer of virgin grades is very much in the hands of those responsible for administering the Government's policy of bulk purchasing, which means that the trade has to take what it is given, and, since the utmost secrecy is preserved about the official buying programme, manufacturers are not likely to know until the last minute what brands they are going to receive.

Scrap Market

In the acquisition of scrap a much happier state of affairs prevails, for this branch of the non-ferrous industry remains in the hands of experts, *i.e.*, the metal merchants, who are willing and able to spread their nets very wide in the search for material. Moreover, they are well versed in the intricacies of the trade and the country is very well served by their knowledge and energy. In plain English they have an incentive, that of earning a livelihood, and are not merely part of a huge and ever-expanding bureaucracy. In the secondary metal section of the industry, buyer and seller make and maintain the closest contacts, so that disputes are rare, although dealing in scrap is notoriously an involved and difficult matter. Now, with the end of the seller's market in sight and the non-ferrous price structure cracking, the scrap merchants are much in need of a hedging medium to protect their holding, but so far the Government has not shown any sign of relinquishing its struggle to make bulk purchasing serve satisfactorily as a substitute for free enterprise. It is understood that some pressure is being brought to bear on the authorities for a reopening of the metal exchange, but nothing definite or official has emerged so far. No one, of course, would expect conditions of trading on London's terminal market to be, in the initial stages, of the same quality as before the war, but unless a start is made some time we shall never get anywhere.

The Post-War Position

When the fighting came to an end in 1945, and indeed even before the war ended, there was a fairly general impression that, with the exception of tin, metals would be in excess supply. Even the shortage of lead was not foreseen and gloomy prophecies of falling values were heard in many directions. Things fell out very differently, and over a period of more than eighteen months the greatest bull market in the history of the non-ferrous metals has been seen. Now it is over, or at any rate the end is in sight, and copper has already broken back sharply from the highest level (24 cents was reached in the United States). During 1946 buyers in the U.K. simply could not go wrong, for owing to the inflexibility of the bulk purchasing system, the Ministry's controlled prices lagged behind world values and users were given, not *one* chance to come again, but dozens. The end of the war undoubtedly left this country collectively with a very long position in metals, and although much of this ran off on the way up, if only because the Government drastically reduced stocks during 1945, it is pretty certain that a lot of profit must have accrued merely as the result of spasmodic prices advances announced by the authorities. At the end of last year, for example, copper jumped overnight from £98 to £117. Scrap, of course, followed the same road, but the dealers scented trouble before the Ministry took its final plunge (a very ill-advised one!) and put copper up to £137. People bought at that level, because they could not help themselves, but it is safe to say that it was always regarded with trepidation and short term cover was the rule.

Free Market Sought

Now we have reached a point when everybody has come to the same conclusion, namely, that there is nothing left to go for on the bull tack and that at any moment an awkward break in values may occur. Sellers would very willingly sell forward at these prices, but buyers shudder at the thought of covering ahead and are doing their utmost to arrange matters so that their commitments are down to a minimum. They are, in fact, striving to manage their economy on a hand-to-mouth basis, which means that everything they buy is wanted in a great hurry. This kind of phobia has attacked consumers before and on such occasions the merchants, dismantling contractors, stockists and others have contented themselves by allowing material to accumulate in the sure and certain expectation that sentiment would change in due course. But they took no risk in this matter, for the future's market enabled them to insure against a fall in price by means of hedging. That to-day is impossible and the result is that the merchants are very loath to buy anything unless they can be quite sure of disposing of the parcel at the same time, thus making certain of securing a profit on the transaction. Purchasers are inclined to be independent, for they are still holding cover secured on the way up and standing at a relatively favourable price. And so we have something closely akin to stagnation! Well may the metal fraternity cry "Give us back the free market."

Need for Government Guidance for Industry

Demand by Chambers of Commeree

"Grave anxiety as to elements in the situation upon which the nation is still being left without guidance" is expressed by the Executive Council of the Association of British Chambers of Commerce in a statement on the economic crisis which they have submitted to the Prime Minister. After remarking that so far the policy of the Government seems to be one of belated expedients, largely negative, the statement lists matters which "should be dealt with positively," including drastic cuts in Government expenditure, deferment of capital expenditure by the Government, local authorities and by industry, postponement of nationalisation plans which do not ensure immediate reductions of costs, increased coal production, longer hours in essential industries as soon as fuel and power and raw materials are available, increased Empire food production, and an immediate revision of controls.

The statement points out that there are two other major points which are gravely disturbing those responsible for the conduct of industry. "The first is this—while it is obvious that there must be some concerted plan to secure a substantially increased volume of exports, how long can one rely upon oversea demands being maintained? The second disturbing question is, to what further extent will the costs of production rise? How are we to compete if the costs of coal and coke, iron and steel, transport, gas and electricity, and wages are allowed to soar unchecked? It has become the duty of the Government to call a halt to these increases.

"In regard to wages the principle of payment by results should be applied wherever possible. This will invo've the reconsideration of the mechanism of P.A.Y.E. In regard to raw materials the present expensive system of bulk buying by Government departments should be terminated and the purchase of commodities conducted through the normal channels of trade."

Gazette

STEVENSON ASSEMBLIES (ENGINEERS), LIMITED, is being wound up voluntarily. Mr. E. S. Browne, 41, North John Street, Liverpool, is the liquidator.

DARNALL CRAMPS, LIMITED, is being wound up voluntarily for the purposes of reconstruction. Mr. E. Baldwin, 12, Waingate, Sheffield, is the liquidator.

MR. A. W. HUNTER, 185-188, High Holborn, London, W.C.1, has been released from his position as liquidator of Newman Engineering, Limited, as from August 1 last.

J. E. HAYDEN, LIMITED, colliery engineers, of Darnall Road, Sheffield, is being wound up voluntarily for the purposes of reconstruction. Mr. E. Baldwin, 12, Waingate, Sheffield, is the liquidator.

Production Cost and Export Trade

Value of Scientific Research

In his presidential address at the opening meeting of the 1947-48 session of the Institute of Marine Engineers on September 9, Sir Amos L. Ayre said that in recent times we had heard much concerning the vital need to increase the volume of our exports, but little had been said as to the ability to export being ultimately dependent on the price of our products. If our production cost, compared with that of our competitors, was too high, the volume would actually fall. It was this feature on which emphasis should be placed as the first rational step towards the effort to increase the volume of our exports.

Steps should be taken now to prepare against the universal condition of a buyer's market that would inevitably emerge, and perhaps as suddenly and unannounced as it did after the first world war. The elementary fact that this country's ability to support its relatively large population depended on efficient and economical production must be realised by all if we were to survive. Sir Amos said the effect of a shorter working week also called for very serious thought. Productive plant that now ceased its five-day operation on a Friday evening remained dormant for over 60 hours before the restart on Monday. Under such conditions there was the need more than ever to make the fullest use of methods of production based on the scientific researches and studies of those whose responsibility it was technically to direct, and all traditional restriction should make way for their introduction. Because of the many current handicaps in our efforts to export our products, and which it must be our constant effort to overcome, our invisible exports became more than ever vital and important.

United Kingdom Tin Position

The Ministry of Supply has released the following figures showing the United Kingdom tin position for the month of July:—

			Ministry.	Consumers.
			Long tons.	Long tons.
TIN METAL:				
Stocks at July 1			5,219	3,824
Arrivals			—	—
Production			2,947	—
			8,166	3,824
Deliveries:				
To U.K. consumers		2,407	—	2,407
For export		72	2,479	—
			—	6,231
Consumption			—	2,296
Stocks at July 31			5,687	3,935*
TIN ORE (Tin content):				
Stocks in U.K. at July 1			6,306	—
Stokes in U.K. at July 31			7,577	—

* Calculated. Reported 3,574 tons.

Manufacturers and Present-day Needs

Views Expressed to Sir S. Cripps

The President of the Board of Trade promised to give sympathetic consideration to suggestions put before him last week by a deputation from the National Union of Manufacturers. A joint statement issued after the meeting said that Sir Stafford had promised to bear in mind the representations made to him in discussions with his colleagues. Sir Stafford was pleased to hear that the Union had under consideration plans for enabling small firms to play a more effective role in the export trade by group or collective action.

The deputation consisted of Sir Patrick Hannon, president, Sir Leonard Browett and Mr. Frank D. O. Dirizzi, chairman of the Union's finance committee.

In its statement to the President of the Board of Trade the deputation emphasised that the Union, representing upwards of 4,000 British manufacturers, wished to do everything in its power to help the nation in the present economic crisis. The Union had always striven for freedom for private enterprise and initiative, while recognising that under existing conditions there must be certain controls—for example, of raw materials in short supply. But it urged strongly that these controls should be strictly confined to those cases where the need for them could be fully demonstrated and that they should be administered with the minimum of form-filling and formality and, whenever possible, with the active co-operation of an organised industry.

Review of Capital Expenditure

"The present situation of the country demands a stringent review of all schemes of capital expenditure, whether by the Government or by industry, with a view to ensuring that our available resources of labour and materials are directed into those channels which will give most help to the maintenance and development of our export trade. All Government expenditure must be rigorously examined and rigorously cut down. Taxation is at far too high a level. It not only inflates production costs, but is a positive discouragement to enterprise and work in the case of both employers and employees."

The statement pointed out that schemes of social betterment, however desirable in themselves, would have to be deferred until happier times and until we could afford them. Industry could not carry the burden of these services—and of the greatly increased staffs now working in Government and local government offices throughout the country—and be successfully competitive in overseas markets. Apart from the actual cost, every man and woman who could be released was badly needed in productive industry.

The National Union had always been of the opinion that the Government's coal production target of 200,000,000 tons a year was too low, and would like to see the target set at 250,000,000 tons, which would enable us both to supply our own industries and to resume in some measure our pre-war export trade, which would give us such enormous relief in many directions, and not least in the supply of raw materials.

Referring to the iron and steel industry, the deputation stated that the Union earnestly hoped that any proposals for nationalisation would not be proceeded with. To do so at the present juncture would certainly be fatal to the attainment of the target production of 14,000,000 tons of steel in 1948 and would defeat many schemes for expansion of industrial output. Industry must have an adequate supply of steel of suitable quality.

World Copper Production

Dominating Position of British Empire

The British Commonwealth now leads the world in the production of copper, the annual output being approximately 700,000 short tons, compared with 604,000 short tons, the next largest output, produced by the United States. Consumption of copper continues to increase, states the current issue of the Bulletin of the Copper Development Association. For 1946 it averaged 27,100 tons a month in this country, compared with 24,100 tons in 1945 and 21,500 tons in 1938. The American demand is extremely heavy and cannot be satisfied by domestic production, with the inevitable result that competition for supplies outside the United States is severe.

Figures, given below (in thousands of short tons), indicate the dominating position of the British Empire, second only to that of Latin America, in potentiality as an exporting community.

	Reserves.	Annual production.	Annual requirements.
United States	20,000	604	1,268
Latin America	28,100	600	10
British Empire	25,500	700	392
Europe (excl. Russia)	2,200	150	759
Russia	10,000	390	172
Africa (excl. British Empire) ..	7,360	160	(small)
Far East (excl. British Empire) ..	500	50	210
Total	93,660	2,654	2,811

The final column gives the annual requirements of new metal, excluding scrap, and indicates that the world demand for copper is somewhat higher than current world production, leading to depletion of stocks.

It is clear, the C.D.A. Bulletin states, that the United States and Europe are the chief buyers of copper, while Latin America and the British Empire are the only communities with any considerable production in excess of their annual requirements. The most important information to be derived from the data, however, is that at the present rate of production the reserves cited will be exhausted in 35 years. Lower-grade ores, at present uneconomical to work, may have to be used, and much activity in prospecting for new deposits is in progress, especially in America. Unexplored reserves in Rhodesia are reported to be very extensive, and may be supplemented by deposits in South-West Africa.

News in Brief

S. WOLF & COMPANY, LIMITED, manufacturers of portable electric tools, of Hanger Lane, Ealing, London, W.5, have recently extended their works.

THE FALKIRK IRON COMPANY, LIMITED, are to erect workmen's baths and changing rooms and a new suite of offices at an estimated cost of £24,000.

MUREX, LIMITED, propose to offer 400,000 new 4 per cent. cumulative redeemable preference shares of £1 each to holders of preference and ordinary stock.

CAMMELL LAIRD & COMPANY, LIMITED, have received an order for four motor vessels for the Argentine State Merchant Fleet of an aggregate displacement of 40,600 tons.

WOMEN WELDERS are to be employed in Tees-side shipyards. They will be employed mainly on preliminary track welding, leaving more exacting work to men.

SULLIVAN MACHINERY COMPANY, LIMITED, Shrewsbury, announce that their name has been changed to Joy-Sullivan, Limited. Their telephone number is now Shrewsbury 3017.

HEENAN & FROUDE, LIMITED, structural manufacturing engineers and ironfounders, of Worcester, are appealing at a public inquiry at Droitwich to-day (Thursday) against a decision of Droitwich Rural District Council not to allow them to develop at Blackpole on the ground that the area should be a green belt.

A "SHOW DAY" held recently at the Duston, Northants, branch of British Timken, Limited, attracted a large crowd. The programme included an exhibition illustrative of the uses to which Timken bearings are put, an engineering exhibition, and a variety of outdoor displays. The proceeds were devoted to St. Dunstan's.

FOLLOWING EXHAUSTIVE hull and machinery trials carried out in the N.P.L. tank at Teddington, the Dundee Harbour Trustees have decided to build a twin-screw Diesel-electric ferry for the Dundee-Newport (Fife) service. Plans and specifications are being prepared on behalf of the trustees by the Caledon Shipbuilding & Engineering Company, Limited.

THE DIRECTORS OF Davis & Timmins, screw manufacturers, of Walthamstow, London, E.17, have decided to offer to the ordinary shareholders on the register on September 10 the right, exercisable up to October 7, to subscribe for 50,000 new ordinary shares of 5s. each at the price of 20s. per share (payable in full on application) in the proportion of one new share for every eight shares held, such new shares to rank *pari passu* with the existing ordinary shares, with the exception of the interim dividend for 1947 declared on September 1.

ACCORDING TO A New York report, the U.S. Government is returning to near wartime control over steel exports. As from October the export licences will be issued on individual orders only with limitations on the amount of steel a country may receive. Pig-iron, iron and steel scrap, sheet steel and boiler plate will be affected. Although steel exports are limited under current procedures, licences are issued on an overall tonnage basis. Priority will be given to shipments destined for reconstruction and basic industries abroad, the Department of Commerce states.

Obituary

MR. JOHN HOLLIS, who died recently, was for 44 years representative for Scotland for Thos. Firth & John Brown, Limited, Sheffield. He was 70 years of age.

MR. EDWIN JOHN ROBERTS, who has died at the age of 69, had been employed by the Park Gate Iron & Steel Company, Limited, for 50 years. He was manager of the basic-slag plant for over 30 years.

MR. EDWARD JOHN LUCAS GARDINER, who died suddenly on September 2, was chairman of Gardiner, Sons & Company, Limited, manufacturers of steel windows, hand-power lifts, etc., of Bristol. He was 72.

MR. ROBERT BLACKADDER, sole partner of Blackadder Bros., mechanical engineers and foundrymen, of Falkirk, has died at the age of 70. The company was established in 1851, but the name of Blackadder has been associated with engineering in the town for nearly 200 years.

MAJOR J. S. BAKER, a director and former chairman of Baker Perkins, Limited, manufacturing engineers, etc., of Peterborough, died suddenly in New York on August 31. He was in the United States for a short holiday and to carry out negotiations with the company's American associate company. Major Baker, who was 66 years of age, was a brother of Mr. Philip Noel-Baker, M.P., Secretary of State for Air.

MR. WILLIAM ROBERT GERALD WHITING, who died recently, was general manager fom 1928 to 1934 to Sir W. G. Armstrong, Whitworth & Company, Limited, Newcastle-upon-Tyne. From 1906 to 1913 he was, first, a draughtsman in the drawing office of the company, engaged on battleship construction, and then assistant chief draughtsman, in the calculations room. From 1913 to 1918 he was outside manager for submarine construction at Elswick. Mr. Whiting had been a member of the Council of the Institution of Naval Architects since 1929. He was 63 years of age.

MR. JOHN SHEPPARD, a director of Richard Sutcliffe, Limited, conveyor manufacturers, of Horbury, near Wakefield, died on August 28, aged 65. Mr. Sheppard, who was related to the Sutcliffe family, entered the works at Horbury in 1906, about a year after its establishment. He became chief designer of the company and well known in the coal-mining industry. Shortly after the formation of the present company in 1932, Mr. Sheppard was appointed secretary, and later a director, a position he retained until his death. He had been in ill-health for many years and was compelled to relinquish an active business career in 1938. After that, however, he was frequently consulted on engineering problems by the company.

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Company News

(Figures for previous year in brackets.)

British Ropes—Interim dividend of 5% (same).

Glover & Main—Interim dividend of 5% (same).

Hunter-Penrose—Interim dividend of 10% (same).

Small & Parkes—Interim dividend of 10% (same).

E. H. Bentall & Company—Dividend of 10% (same).

W. H. Dorman & Company—Dividend of 37½% (25%).

Kay & Company (Engineers)—Dividend of 20% (17½%).

B. Elliott & Company—Interim dividend of 33⅓% (same).

A. Reyrolle & Company—Interim dividend of 5% (same).

Newton Chambers & Company—Interim dividend of 5% (same).

Qualcast—Final dividend of 40% (same), making 60% (50%).

British Thermostat Company—Interim dividend of 7½% (same).

Quick, Barton & Company—Interim dividend of 2½% (same).

Dubilier Condenser Company (1925)—Dividend of 20% (same).

Strand Electric Holdings—Dividend of 17½% (10% and bonus of 2½%).

Breedon & Cloud Hill Lime Works—Interim dividend of 7½% (same).

Vaughan Bros. (Drop Forgings)—Final dividend of 10%, making 20% (same).

United Flexible Metallic Tubing Company—Interim dividend of 6% (same).

Central Provinces Manganese Ore Company—Interim dividend of 7½% (same).

Clifford Motor Components—Final dividend of 22½% (12½% and bonus of 10%), making 30% (same).

Ransome & Marles Bearing Company—Final dividend of 12½%, making 20% (same) and special bonus of 5% (nil).

Dobson & Barlow (Securities)—Profit for the year ended June 30, £8,591 (£8,005); dividend of 9d. per share (same); forward, £5,658 (£5,325).

Brightside Foundry & Engineering Company—Final dividend of 15% (35%) and bonus of 5% (10%), making 50% (45%). New capital ranks for final payments.

Incledon & Lamberts—Net receipts for the year ended March 31, £15,243 (£13,152); interim dividend of 15% (12½%) already paid; to reserve, £1,500 (same); forward, £735 (£1,174).

G. Beaton & Son—Net profit for 1946, after tax, depreciation, etc., £1,934 (£13,072); transferred from contingencies reserve, £3,500; dividend of 10% (same and bonus of 5%); forward, £1,153 (£1,219).

Lang Bridge—Profit for the year ended June 30, after charging £2,511 (£5,628) for deferred repairs executed during the year, £10,319 (£2,065); to reserve, £7,000 (nil); dividend of 10% (5%); forward, £1,476 (£7,231).

Fodens—Net profit for the year ended May 31, after depreciation, taxation, etc., £60,782 (£50,594); to general reserve, £40,000 (£35,000); directors' fees, £2,225 (same); dividend of 10% (9%); forward, £20,884 (£21,347).

W. N. Froy & Sons—Net profit for 1946, after depreciation, taxation, etc., £34,780 (£19,149); investment reserve not required, nil (£318); to reserve for future taxation, £22,363 (nil); dividend of 12½% (10%); forward, £23,373 (£22,593).

Silentbloc—Net profit for the year ended May 31, after depreciation, taxation, etc., £34,251 (£26,522); to provision for future taxation, £6,660 (£5,750); additional provision for tax, £1,087 (£5,379); final dividend of 16¼% (12½%), making 29½% (25%); forward, £18,017 (£17,982).

Peter Brotherhood—Balance from trading account for the year ended March 31, £68,483 (£72,205); to directors' fees, £1,633 (£1,800); income tax, £36,000 (£41,500); profits tax for the three months to March 31, £1,900; net profit, £28,950 (£28,905); final dividend of 12%, making 20% (same); forward, £150,685 (£145,976).

Dermatine Company—Interest on investments for the year ended June 30, £1,392; tax reserves not required, £10,729; debit on trading and revenue account, £3,140; depreciation, £374; directors' fees, £700; auditors' fees, £157; net profit, £7,752; dividend of 30% (same and bonus of 10%); forward, subject to directors' additional remuneration, £4,421 (£3,881).

Wellman Smith Owen Engineering Corporation—Trading profit to March 31, including £130,096 held in reserve on contracts completed in previous periods now in excess of requirements, sundry income and after providing for depreciation on the same basis as in previous years, £188,551 (£173,597); taxation, £150,000 (£146,338); net profit, £38,551 (£27,259); to general reserve, £10,000 (same); special depreciation, £10,000 (nil); final dividend of 7½%, making 12½% (same); forward, £48,360 (£47,172).

Gas and Hard Coke Prices

Consequent on the increase of 4s. per ton in the pithead price of coal on September 1, an increase of 6s. per ton in the works prices of gas and hard coke has been authorised by the Ministry of Fuel and Power as from September 15. Retail prices of coke will be increased accordingly.

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Raw Material Markets

Iron and Steel

There is no lack of iron ore, limestone, etc., for the blast furnaces, but the position in regard to coking coal is again precarious and may delay the restarting of blast furnaces which were about to be blown in. Coal is the key to the needed expansion of pig-iron production. Meanwhile, more iron is wanted in the steelworks, and foundry outputs are low owing to lack of supplies. The engineering and jobbing foundries have a wider range of choice and if the particular grade of iron required is scarce, a substitute can usually be found. The light foundries, however, which operate on high-phosphorus iron, are badly off; full supplies are not coming through and, as soon as possible, another blast furnace should be lighted up solely to cater for the light-castings trade.

The raising of the German steel target inspires hope that in due time the Ruhr works may be able to provide reasonable tonnages for the British re-rolling industry. The flow of material from across the Atlantic has dwindled almost to vanishing point, and fresh sources of supply are badly needed. Meanwhile, there is a dearth of both sheet bars and billets, and re-rollers are making extensive use of defectives, crops and scrap materials, and are also taking up the somewhat costly outputs of electrically-melted billets.

Better outputs of rolled steel are being achieved and deliveries have been speeded up. Shipbuilders are among the chief beneficiaries, but all the mills have a large accumulation of orders in hand, and there will probably be a fair number of cancellations of uncompleted contracts at the end of the month, which is also the end of Period III. The plate mills have exceptionally heavy commitments in which contracts for sizes under $\frac{1}{2}$ in. show a preponderance, while the sheet mills are fully booked for many months ahead. Tube strip is in strong request; heavy tonnages of rails, joists, channels and sections are on order and the call for steel in the form of arches, props and roofing bars for the collieries is steadily rising.

Non-ferrous Metals

There is little activity in copper at present, and the world price is still nominally about 21.25 cents per lb., f.a.s. New York, for electro. Stocks of copper in the United Kingdom at the end of June were 102,300 tons, the highest since 1945. This figure does not include 11,500 tons held abroad, which in turn excludes quantities at port and in transit.

The chairman of the London Tin Corporation, Limited, Mr. J. Ivan Spens, stated at the annual meeting held recently that, in view of the rising costs of tin production and the possibilities of still further increases in the future, the current tin price did not afford a reasonable profit margin. Apart from the increasing cost of materials, transport, etc., which were doubling pre-war tin-mining costs, the industry would be expected to contribute to the advance of education and social welfare, part of the Colonial development policy. In contrast to these rising costs, the present controlled price of tin was equivalent to £437 per ton, in London, compared with the average price of £226 per ton, in 1939. Thus, although costs had already doubled, the price was still less than double the pre-war figure.

August Iron and Steel Output

Importance of Adequate Coke Supplies

Steel output in August was at an annual rate of 12,178,000 tons, compared with 11,007,000 tons a year in July and 11,747,000 tons in August, 1946. Pig-iron production was at the rate of 7,660,000 tons a year, compared with 7,460,000 tons in July and 7,558,000 tons a year ago.

Steel production in the early part of the month was affected by holidays, but rose during each week of the month and in the last week exceeded the rate of 13½ million tons a year. It will only be possible to maintain this rate if coke supplies are adequate to enable pig-iron production to be expanded to the level needed.

Latest output figures compare as follow with earlier returns:—

	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
	Tons.	Tons.	Tons.	Tons.
1947—1st quarter..	134,400	6,989,000	216,000	11,231,000
2nd quarter	141,600	7,363,000	244,100	12,694,000
July.. ..	143,500	7,460,000	211,700	11,007,000
August ..	147,300	7,660,000	234,200	12,178,000
1946—1st quarter..	145,500	7,566,000	242,600	12,617,000
2nd quarter	150,500	7,827,000	252,100	13,111,000
July.. ..	147,000	7,645,000	226,000	11,759,000
August ..	145,300	7,558,000	225,900	11,747,000

Stock and Sales of Non-ferrous Scrap

The stock of non-ferrous scrap on charge at July 31 was 46,471 tons. Details, issued by the Ministry of Supply, are as follow:— Muffled S.A.A., 2,687 tons; lead and lead alloy, 1,158; copper and copper alloy, 16,794; zinc and zinc alloy, 6,631; other grades, 19,201 tons. The approximate value of the 6,465 tons sold during the two months' period June to July was £450,000.

Material put out to tender during the same period amounted to 3,561 tons, of which 2,563 tons were lead.

During the same period 12,636 tons were invoiced, the value being £938,099.

HUGHES BOLCKOW SHIPBREAKING COMPANY, LIMITED, Blyth, have acquired the former German 5,226-ton cargo vessel Eberstein for breaking-up.

LE TOURNEAU (GREAT BRITAIN), LIMITED, is being wound up voluntarily. Mr. J. M. S. Coates, 31, Mosley Street, Newcastle-upon-Tyne, is the liquidator.